

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application:

LISTING OF CLAIMS

1. (Previously Presented) An optical wavelength division multiplexing network having a multi-layer structure comprising at least three layers, said multi-layer structure comprising:

a highest level network which is a ring network, said highest level network comprising at least one center node and two or more remote nodes which are joined by at least two optical fibers;

at least one intermediate level network which is a ring network, said intermediate level network including one of the nodes belonging to the highest level network or to another intermediate level network immediately above said intermediate level network, as a center node thereof, nodes belonging to said ring network of said intermediate level network being joined by at least two optical fibers; and

a lowest level network which is a star network centered around an access node which is a remote node belonging to said intermediate level network, said access node multiplexing traffic from one or a plurality of optical network units (ONU), said ONU and said access node being directly joined by at least one optical fiber,

wherein said remote nodes amplify optical wavelength division multiplexing signals which are transmitted on an optical fiber of said highest level network to which said remote nodes belong, branch the amplified signals to an optical fiber of said intermediate level network, couple optical wavelength division multiplexing signals,

which are input from an optical fiber of said intermediate level network, to optical wavelength division multiplexing signals transmitted on an optical fiber of said highest level network, and amplify the coupled signals;

wherein said access node amplifies the optical wavelength division multiplexing signals transmitted from said optical fibers of said intermediate level network to which said access node is connected, selects optical signals having wavelengths which correspond to said ONU, outputs the selected signals to said ONU, multiplexes said optical signals transmitted from said ONU, divides the multiplexed signals in a plurality of directions, amplifies the divided signals, and transmits the amplified signals to an optical fiber of said intermediate level network to which said access node is connected; and

wherein the center node belongs to said highest level network and said ONU establishes a direct communication path by using lights of different wavelengths, the optical signals being amplified, branched, and routed at said remote nodes and said access node provided therebetween.

2. (Withdrawn, Previously Presented) The optical wavelength division multiplexing network as described in Claim 1, wherein the highest level network is a first ring network, and the intermediate level network immediately below the highest level network is a second ring network including one or a plurality of access nodes.

3. (Withdrawn, Previously Presented) The optical wavelength division multiplexing network as described in Claim 2, wherein the access nodes where the optical signals from

said ONU are multiplexed transmit and receive optical wavelength division multiplexing signals by using an optical amplifier, an optical switch, and an optical multiplexer/de-multiplexer;

and wherein communication between said center node belonging to said highest level network and said ONU is carried out by using optical amplifiers and passive optical components at a remote node which belongs to a network layer provided above said intermediate level network to which said access nodes belong.

4. (Withdrawn, Previously Presented) The optical wavelength division multiplexing network as described in Claim 3, wherein said passive optical components at the remote node comprises optical couplers.

5. (Withdrawn, Previously Presented) The optical wavelength division multiplexing network as described in Claim 3, wherein said passive optical components at the remote node comprises optical circulators.

6-10. (Cancelled)

11. (Withdrawn, Previously Presented) The optical wavelength division multiplexing network as described in Claim 2, wherein,

at a node belonging to both said first ring network and said second ring network, both ends of at least two looped optical fibers, which join the access nodes belonging to said second ring network, are open; and

said access nodes and said remote nodes do not comprise optical multiplexer/de-multiplexers having wavelength selectability, said ONU themselves having a wavelength de-multiplexing function.

12. (Withdrawn, Previously Presented) The optical wavelength division multiplexing network as described in Claim 11, all the optical wavelength division multiplexing signals, transmitted on at least two optical fibers which are used in said first and second ring networks, are bi-directional, bi-directional amplifiers being used in said remote nodes and said access nodes.

13-14. (Cancelled)

15. (Previously Presented) An optical wavelength division multiplexing network having a multi-layer structure comprising at least three layers, said multi-layer structure comprising:

a highest level network which is a ring network, said highest level network comprising at least one center node and two or more remote nodes which are joined by at least two optical fibers;

at least one intermediate level network which is a ring network, said intermediate level network including one of the nodes belonging to the highest level network or another intermediate level network immediate above said intermediate network, as a center node thereof, access nodes belonging to said ring network of said intermediate level network being joined by at least four optical fibers; and

a lowest level network which is a star network centered around an access node which multiplexes traffic from optical network units (ONU), said ONU and said access node being directly joined by at least one optical fiber,

wherein said remote nodes amplify optical wavelength division multiplexing signals transmitted on said optical fibers of said highest level network to which said remote nodes belong, branch the signals to optical fibers of said intermediate level network, and couple optical wavelength division multiplexing signals which are input from optical fibers of said intermediate level network to optical wavelength division multiplexing signals transmitted on optical fibers of said highest level network, and amplify the coupled signals;

wherein said access node amplifies optical wavelength division multiplexing signals transmitted on optical fibers of said intermediate-level network, to which said access node belongs, branches the amplified signals to said lowest level network for outputting the branched signals to said ONU, multiplexes optical signals transmitted from said ONU, divides the multiplexed signals in a plurality of directions, couples the divided signals to optical wavelength division multiplexing signals transmitted on optical fibers of said intermediate level network to which said access node is connected, and amplifies the coupled signals; and

wherein the center node belongs to said highest level network and said ONU establishes a direct communication path by using lights of different wavelengths, the optical signals being only amplified, branched, or routed, at said remote nodes and said access node provided therebetween.

16. (Previously Presented) The optical wavelength division multiplexing network as described in Claim 15, wherein, at a node belonging to said intermediate level network, one end of at least four looped optical fibers, which join the access nodes belonging to said intermediate level network, is open; and

said access nodes and said remote nodes do not comprise optical multiplexer/de-multiplexers having wavelength selectability, said ONU themselves having a wavelength de-multiplexing function.

17-21. (Cancelled)

22. (Previously Presented) The optical wavelength division multiplexing network as described in Claim 1, wherein communication between said ONU and said access nodes is doubled by using radio communications .

23. (Previously Presented) The optical wavelength division multiplexing network as described in Claim 1, said optical multiplexer/de-multiplexer provided at said access node being provided at a remote terminal instead.

24. (Original) The optical wavelength division multiplexing network as described in Claim 23, wherein communication between said ONU and said access nodes is doubled by using radio communications.

25-33. (Cancelled)

34. (Previously Presented) A node apparatus in an optical network having a multi-layer structure comprising at least two layers, the node apparatus connected to a highest level network or an intermediate level a network immediately above a lowest level network establishing a direct communication path with optical network units (ONU) and transmitting data by using optical signals at first wavelengths allocated to each of said ONU, and said ONU transmitting the data to the node apparatus connected to a network provided above said lowest level network by optical signals at second wavelengths which are different from the first wavelengths, the node apparatus being connected to said lowest level network, said node apparatus comprising:

an optical switch which selects one of the optical signals which are input from optical fibers of the highest level network or the intermediate level network;

a first optical amplifier which amplifies, among the optical signals which are input from the optical fibers comprising the highest level network or the intermediate level network, at least the optical signal being selected by said optical switch;

an optical multiplexer/de-multiplexer which, based on the optical signal selected by said optical switch, selects an optical signal having a wavelength which corresponds to said ONU, outputs the selected signal to said ONU, and multiplexes the optical signals transmitted from said ONU;

an optical divider which divides the optical signal, multiplexed by said optical multiplexer/de-multiplexer, into a plurality of directions, and transmits the divided signals to the optical fibers of the highest level network or the intermediate level network;
and

a second optical amplifier which amplifies the optical signals which are transmitted to the optical fibers of the highest level network or the intermediate level network.

35-38. (Cancelled)

39. (Previously Presented) A node apparatus in an optical network having a multi-layer structure comprising at least two layers, said node apparatus, which is connected to a highest level network and becomes a final multiplexing destination of traffic, establishing a direct communication path to optical network units (ONU) and transmitting data by using optical signals at wavelengths allocated to said ONU, said ONU transmitting data by using optical signals at said wavelengths to said node apparatus, said node apparatus comprising:

a plurality of optical de-multiplexers which de-multiplex optical wavelength division multiplexing signals, input from optical fibers comprising said highest level network, to optical signals at each wavelength;

a plurality of optical receivers which convert the optical signals which have been de-multiplexed by said optical de-multiplexers to electrical signals;

a plurality of selectors which selectively output either of the outputs from said plurality of optical receivers;

a signal termination section which performs predetermined electrical processing to the electrical signals which have been selected by said selectors, and outputs a plurality of groups of electrical signals;

a plurality of optical senders which convert the electrical signals output from the signal termination section to a plurality of optical signals having different wavelengths;
and

a plurality of optical multiplexers which multiplex the optical signals output from said optical senders, and output the multiplexed signals to optical fibers comprising said highest level network.

40-47. (Cancelled)

48. (Withdrawn) The optical wavelength division multiplexing network as described in Claim 15 wherein communication between said ONU and said access nodes is doubled by using radio communications.

49-51. (Cancelled)

52. (Withdrawn) The optical wavelength division multiplexing network as described in Claim 15 wherein said optical multiplexer/de-multiplexer provided at said access node is provided at a remote terminal instead.

53. (Cancelled)